

CHAPTER 1 USE OF COMPUTER AIDED DRAFTING AND DESIGN

SECTION 1-1 GENERAL OVERVIEW AND DRAWING GUIDELINES

1-1.1 Overview of CADD Use

Computer Aided Drafting and Design (CADD) has been used by Caltrans for more than 20 years. CADD is an integral part of the project delivery process, from project initiation through completion of the as-built plans.

CAiCE is currently the standard roadway design software. CAiCE files are needed by surveys and construction to efficiently stake the project for the contractor to build. The Survey File Checklist, located in Appendix QQ of the Project Development Procedures Manual (PDPM), details the information the design engineer needs to provide surveys. Delivering all the files that surveys needs is now a requirement for final Ready-to-List (RTL) Certification.

MicroStation is the standard drafting software for Caltrans. HQ CADD is currently phasing in the use of MicroStation V8 at Caltrans. Phase 1 continued the process of only creating, using and submitting Version 7 file formats for all MicroStation design files to minimize backward compatibility issues. Phase 2 will be implemented on February 1, 2008. With Phase 2, Caltrans will begin accepting a MicroStation V8 file format for Plans, Specifications and Estimate (PS&E) submittals. The V8 file format must adhere to the current Caltrans CADD standards as

defined in Section 4.1 of this CADD Users Manual. With Phase 2 of V8, there will be several defined groupings of 63 levels for various Caltrans disciplines. Formerly only 63 levels were available in MicroStation. Other restrictions for use of a V8 file format are:

- Use only the “Default” model space
- Use State Plane Coordinates
- Use only Caltrans V8 seed files
- For every MicroStation highway design file a resolution of 10,000 for the "Working Units" is still required.
- U.S. Survey foot must be defined as the default for the "foot unit"
- Use the DGNLIB supplied by Caltrans

The current Caltrans official plotting solution is Interplot. Project plans submitted to Division of Engineering Services - Office Engineer (DES-OE) as part of the plans, specifications and estimate (PS&E) submittal package, must have an individual Interplot parameters file called an iparm (.i) for each MicroStation design file (DGN). Each DGN file contains just one individual plan sheet, with no reference files attached. Each project plan sheet is a stand-alone legal document when it is part of the awarded contract documents. The submittal of models representing the entire limits of a project and containing individual sheet files are not accepted for PS&E submittals.

1-1.2 Electronic Data and Project Delivery Process

Electronic data is used throughout the project delivery process from the inception of a Project Initiation Document (PID) such as a Project Study Report (PSR) or Project Report (PR) to the completion of the as-built plans. Information used for an advance

planning study, environmental document or corridor study may not be appropriate or accurate enough for the final design of a project. For guidance on reports, requests and submittals needed for developing and completing a project, see Chapter 14 of the Project Development Procedures Manual.

Before requesting surveys and mapping or acquiring existing data (vector or raster), decide who will need to use or receive the information and what really needs to be included in the final product. When developing a project for PS&E, keep in mind what electronic files construction or surveys will need to build the project, including the completion of the as-built plans.

An informal project assessment meeting (sometimes called a scoping meeting) early in the project delivery process will help identify the functional units needed to deliver their portion of the project.

A project assessment meeting will also assist the engineer in determining the extent of electronic data (i.e. mapping or surveys) needed and the accuracy required. Early identification of each functional unit's electronic data needs and what they will be required to deliver will allow for more effective and efficient sharing of the project electronic files.

One important item commonly overlooked on many projects is the early face-to-face field meeting onsite at the project location between the Project Engineer and the functional units such as Construction, Maintenance, Right of Way, Surveys, Hydraulics and Environmental. A face-to-face meeting prior to any constructibility review will promote teamwork, the sharing of critical project decisions, and will minimize last minute changes and surprises.

Knowing what the final products are and who will receive them early in the design process, will minimize duplication of work and contribute to the on-time delivery of a quality project.

1-1.3 Types of Engineering Drawings

Engineering drawings are generally categorized into two types, geographically oriented and nongeographically oriented. Geographically oriented drawings have graphic elements (lines, symbols) located on the drawing by their on-ground horizontal (N, E) locations. For example, a layout sheet is geographically oriented. Geographic drawings are created by combining levels of data from a master drawing. Refer to Section 2.4 of the CADD Users Manual. Nongeographically oriented drawings generally have graphic elements which describe the dimensional relationship of an object or planned construction without a direct relationship to specific on-ground horizontal locations. An example is a detail drawing for a drainage feature.

1-1.4 General Drawing Guidelines

Line Work

Line quality is extremely important to the readability of CADD drawings. Line widths are varied to distinguish certain classes of features from others. The more basic outlining features are emphasized with heavier (wider) lines. Examples are station lines, base lines, construction layout lines, and the basic outline of objects. Medium weight lines are used for proposed construction and right of way. Light lines are used for existing topography, dimensioning, and other less important details. Dashed or dotted lines are used to

distinguish existing from proposed work. For additional drafting conventions and standards regarding line weights, line styles and graphical representation of features refer to the CADD Users Manual, the Standard Plans, and Section 2-1.2 of this manual.

Text

Refer to Section 2.6 of the CADD Users Manual for text sizes and fonts. Caltrans preference is the use of uppercase text, because it is easier to distinguish characters within the message. See Section 2-1.2 of this manual regarding placement of text.

Scales

Recommended scales for project plans and other drawings are discussed in Section 2-1.2 of this manual.

1-1.5 Preparing Drawings

Generally, there is no prescribed sequence in which to prepare drawings. Each type of drawing involves different preparation procedures.

When preparing geographically oriented drawings, it is important that the physical features be drawn in exact position using actual coordinate values. Caltrans does not draw to a scale, it only plots to a given scale. Labels, dimensions, notes, and other data should be positioned to present the most understandable picture. For example, the area within the right of way may be required for data pertinent to construction. Notes and other data should be placed outside the right of way.

To be effective, an engineering drawing must be clear, concise, complete, accurate, and functional. It is a graphic set of instructions.

1-1.6 Content and Development of Electronic Files

Electronic files for project plans should generally contain the following information and are developed in this order:

Master Topographic File

This file contains mapping that depicts existing conditions of a project. Existing topography may be provided by scanned maps, digitized maps or maps from ground surveys (digital terrain models).

This file will contain natural and man-made features such as:

- Roads and streets
- Driveways, sidewalks and curbs
- Streams, ditches and drains
- Bridges and culverts
- Utilities (railroads, poles, and pipelines)
- Fences and gates
- Buildings
- Trees and shrubs
- Contours of the original terrain

Topographic symbols are shown on Standard Plan A10D.

Master Design File

This file contains all proposed permanent design information for a project.

This file will contain features such as:

- Station lines
- Station tick marks and annotations
- Alignment line and route identification
- Layout lines
- Right of way lines
- North arrow
- Driveways, sidewalks and curbs
- Edge of roads
- Toe of slope and top of cut
- Construction features (i.e. guard railing, fences, sound walls, etc.)
- Drainage features
- New utilities

Construction symbols are shown on Standard Plan A10C.

Contract Plan Files

The contract plan sheet file contains information that is unique to that particular plan sheet. It generally includes labeling, descriptions, notes or symbology that defines or quantifies the items of work shown on that plan sheet. Specific plan sheet content, checklists and example plan sheets are contained in Section 2-2 of this manual.

Caution should be exercised when using completed projects as guidance in preparing new projects. Due to a variety of reasons, a completed project may not have been prepared in an adequate manner. Do not perpetuate mistakes. The instructions in this manual take precedence over the use of a completed project as guidance in developing new projects.